Geometry

Content Standards

2016

Compiled using the Arkansas Mathematics Standards

Course Title:	Geometry
Course/Unit Credit:	1
Course Number:	431000
Teacher Licensure:	Please refer to the Course Code Management System (https://adedata.arkansas.gov/ccms/) for the most current licensure codes.
Grades:	9-12
Prerequisite:	Algebra I or Algebra A/B

Course Description: "The fundamental purpose of the course in Geometry is to formalize and extend students' geometric experiences from the middle grades. Students explore more complex geometric situations and deepen their explanations of geometric relationships, moving towards formal mathematical arguments. Important differences exist between this Geometry course and the historical approach taken in Geometry classes. For example, transformations are emphasized early in this course. Close attention should be paid to the introductory content for the Geometry conceptual category found in the high school AMS.

This document was created to delineate the standards for this course in a format familiar to the educators of Arkansas. For the state-provided Algebra A/B, Algebra I, Geometry A/B, Geometry, and Algebra II documents, the language and structure of the Arkansas Mathematics Standards (ASM) have been maintained. The following information is helpful to correctly read and understand this document.

"**Standards** define what students should understand and be able to do.

Clusters are groups of related standards. Note that standards from different clusters may sometimes be closely related, because mathematics is a connected subject.

Domains are larger groups of related standards. Standards from different domains may sometimes be closely related." - http://www.corestandards.org/

Standards do not dictate curriculum or teaching methods. For example, just because topic A appears before topic B in the standards for a given grade, it does not necessarily mean that topic A must be taught before topic B. A teacher might prefer to teach topic B before topic A, or might choose to highlight connections by teaching topic A and topic B at the same time. Or, a teacher might prefer to teach a topic of his or her own choosing that leads, as a byproduct, to students reaching the standards for topics A and B.

The standards in this document appear exactly as written in the ASM. Italicized portions of the standards offer clarification. The Plus Standards (+) from the Arkansas Mathematics Standards may be incorporated into the curriculum to adequately prepare students for more rigorous courses (e.g., Advanced Placement, International Baccalaureate, or concurrent credit courses).

Geometry

Domain	Cluster	Course Emphases
Congruence		
	1. Investigate transformations in the plane	Supporting
	2. Understand congruence in terms of rigid motions	Major
	3. Apply and prove geometric theorems	Major
	4. Make geometric constructions	Supporting
	5. Logic and Reasoning	
Similarity, Right Triangles, and Trigonometry		
	6. Understand similarity in terms of similarity transformations	Major
	7. Apply and prove theorems involving similarity	Major
	8. Define trigonometric ratios and solve problems involving right triangles	Major
	9. Apply trigonometric to general triangles	
Circles		
	10. Understand and apply theorems about circles	Additional
	11. Find arc lengths and areas of sectors of circles	Additional
Expressing Geometric Properties with Equations		
	12. Translate between the geometric description and the equation of a conic section	Additional
	13. Use coordinates to prove simple geometric theorems algebraically	Major
Geometric measurement and dimension		
	14. Explain volume formulas and use them to solve problems	Additional
	15. Visualize relationships between two-dimensional and three-dimensional objects	Additional
Modeling with Geometry		
	16. Apply geometric concepts in modeling situations	Major

Asterisks identify potential opportunities to integrate content with the modeling practice

Domain: Congruence

Cluster(s): 1. Investigate transformations in the plane
2. Understand congruence in terms of rigid motions
3. Apply and prove geometric theorems
4. Make geometric constructions
5. Logic and Reasoning

HSG.CO.A.1	1	Based on the undefined notions of point, line, plane, distance along a line, and distance around a circular arc, define: • Angle • Line segment • Circle • Perpendicular lines • Parallel lines	Supporting
HSG.CO.A.2	1	• Represent transformations in the plane (*e.g. using transparencies, tracing paper, geometry software, etc.).* • Describe transformations as functions that take points in the plane as inputs and give other points as outputs. • Compare transformations that preserve distance and angle to those that do not. (*e.g., translation versus dilation).*	Supporting
HSG.CO.A.3	1	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and/or reflections that carry it onto itself.	Supporting
HSG.CO.A.4	1	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.	Supporting
HSG.CO.A.5	1	• Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure, (*e.g., using graph paper, tracing paper, miras, geometry software, etc.).* • Specify a sequence of transformations that will carry a given figure onto another.	Supporting
HSG.CO.B.6	2	• Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure • Given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.	Major
HSG.CO.B.7	2	Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.	Major
HSG.CO.B.8	2	Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. Investigate congruence in terms of rigid motion to develop the criteria for triangle congruence (ASA, SAS, AAS, SSS, and HL) *Note: The emphasis in this standard should be placed on investigation*	Major

Key:

ASM Domain and Standard #	ASM Cluster	ASM Standard	Course Emphases (Category)

HSG.CO.C.9	3	Apply and prove theorems about lines and angles. *Theorems include but are not limited to: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.* Note: Proofs are not an isolated topic and therefore should be integrated throughout the course.	Major
HSG.CO.C.10	3	Apply and prove theorems about triangles. *Theorems include but are not limited to: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.* Note: Proofs are not an isolated topic and therefore should be integrated throughout the course.	Major
HSG.CO.C.11	3	Apply and prove theorems about quadrilaterals. *Theorems include but are not limited to relationships among the sides, angles, and diagonals of quadrilaterals and the following theorems concerning parallelograms: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.* Note: Proofs are not an isolated topic and therefore should be integrated throughout the course.	Major
HSG.CO.D.12	4	Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). *Constructions may include but are not limited to: copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.* Note: Constructions are not an isolated topic and therefore should be integrated throughout the course.	Supporting
HSG.CO.D.13	4	Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. Note: Constructions are not an isolated topic and therefore should be integrated throughout the course.	Supporting
HSG.CO.E.14	5	Apply inductive reasoning and deductive reasoning for making predictions based on real world situations using: • Conditional Statements (inverse, converse, and contrapositive) • Venn Diagrams	Supporting

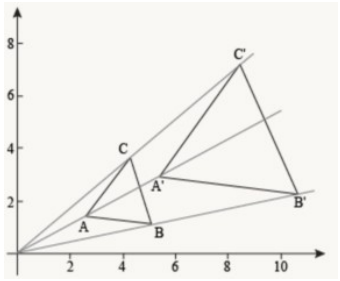
Key:

ASM Domain and Standard #	ASM Cluster	ASM Standard	Course Emphases (Category)

		Note: This is not intended to be an isolated topic but instead to support concepts throughout the course.	

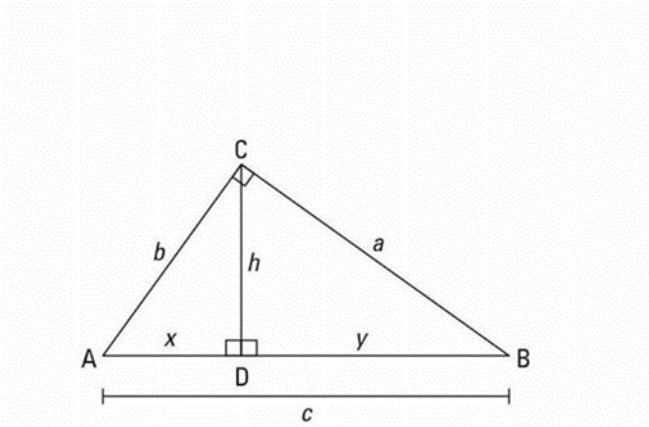
Domain: Similarity, Right Triangles, and Trigonometry

Cluster(s): 6. Understand similarity in terms of similarity transformations
7. Apply and prove theorems involving similarity
8. Define trigonometric ratios and solve problems involving right triangles
9. Apply trigonometry to general triangles

HSG.SRT.A.1	6	Verify experimentally the properties of dilations given by a center and a scale factor. • A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. • The dilation of a line segment is longer or shorter in the ratio given by the scale factor.  http://www.shmoop.com/common-core-standards/ccss-hs-g-srt-1a.html	Major
HSG.SRT.A.2	6	Given two figures: • Use the definition of similarity in terms of similarity transformations to determine if they are similar • Explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.	Major
HSG.SRT.A.3	6	Use the properties of similarity transformations to establish the AA, SAS~, SSS~ criteria for two triangles to be similar.	Major
HSG.SRT.B.4	7	Use triangle similarity to apply and prove theorems about triangles.	Major

Key:

ASM Domain and Standard #	ASM Cluster	ASM Standard	Course Emphases (Category)

		Theorems include but are not limited to: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.  $\frac{x}{b}=\frac{b}{c}, \quad \frac{y=c-x}{a}=\frac{a}{c}$ $x=\frac{b^2}{c}, \quad c-x=\frac{a^2}{c}$ $x+(c-x)=c$ $\frac{a^2}{c}+\frac{b^2}{c}=c$ $a^2+b^2=c^2$	
HSG.SRT.B.5	7	• Use congruence (SSS, SAS, ASA, AAS, and HL) and similarity (AA, SSS~, SAS~) criteria for triangles to solve problems • Use congruence and similarity criteria to prove relationships in geometric figures.	Major

Key:

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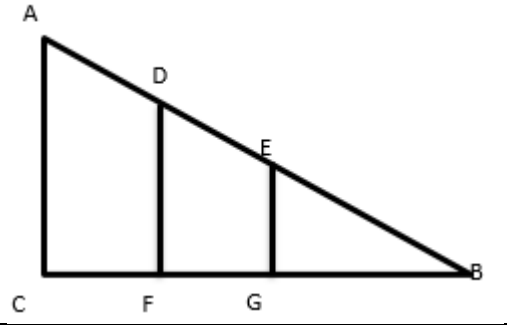
HSG.SRT.C.6	8	Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. *For example: Trigonometric ratios are related to the acute angles of a triangle, not the right angle. The values of the trigonometric ratio depend only on the angle. Consider the following three similar triangles (why are they similar)?* 	Major
HSG.SRT.C.7	8	Explain and use the relationship between the sine and cosine of complementary angles.	Major
HSG.SRT.C.8	8	Use trigonometric ratios, special right triangles, and/or the Pythagorean Theorem to find unknown measurements of right triangles in applied problems. Note: Examples should Including, but are not limited to angles of elevation, angles of depression, navigation, and surveying.	Major
HSG.SRT.D.9	9	(+) Derive the formula A = 1/2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.	Additional
HSG.SRT.D.10	9	(+) Prove the Laws of Sines and Cosines and use them to solve problems.	Additional
HSG.SRT.D.11	9	(+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles Note: Examples should include, but are not limited to surveying problems and problems related to resultant forces.	Additional

Key:

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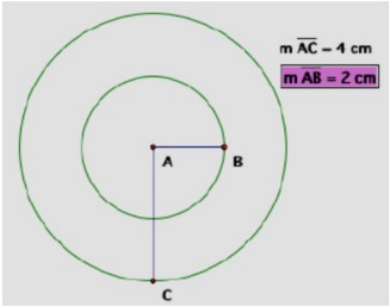
Domain: Circles
Cluster(s): 10. Understand and apply theorems about circles
11. Find arc lengths and areas of sectors of circles

HSG.C.A.1	10	Prove that all circles are similar.  http://www.azed.gov/azcommoncore/files/2012/11/high- school-ccss-flip-book-usd-259-2012.pdf	Additional
HSG.C.A.2	10	Identify, describe, and use relationships among angles, radii, segments, lines, arcs, and chords as related to circles. Note: Examples include but are not limited to the following: the relationship between central, inscribed, and circumscribed angles and their intercepted arcs; angles inscribed in a semi-circle are right angles; the radius of a circle is perpendicular to a tangent line of the circle at the point of tangency.	Additional
HSG.C.A.3	10	• Construct the inscribed and circumscribed circles of a triangle. • Prove properties of angles for a quadrilateral inscribed in a circle.	Additional
HSG.C.B.5	11	• Derive using similarity that the length of the arc intercepted by an angle is proportional to the radius. • Derive and use the formula for the area of a sector. • Understand the radian measure of the angle as a unit of measure. Note: Connected to F.TF.1 (+)	Additional

Key:

ASM Domain and Standard #	ASM Cluster	ASM Standard	Course Emphases (Category)

Domain: Expressing Geometric Properties with Equations
Cluster(s): 12. Translate between the geometric description and the equation of a conic section
13. Use coordinates to prove simple geometric theorems algebraically

HSG.GPE.A.1	12	• Derive the equation of a circle of given center and radius using the Pythagorean Theorem • Complete the square to find the center and radius of a circle given by an equation. Note: Students should also be able to identify the center and radius when given the equation of a circle and write the equation given a center and radius.	Additional
HSG.GPE.A.2	12	(+)Derive the equation of a parabola given a focus and directrix.	Major
HSG.GPE.A.3	12	(+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.	Additional
HSG.GPE.B.4	13	Use coordinates to prove simple geometric theorems algebraically. *For example: Prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).*	Supporting
HSG.GPE.B.5	13	• Prove the slope criteria for parallel and perpendicular lines. • Use the slope criteria for parallel and perpendicular lines to solve geometric problems. Note: Examples should include but are not limited to finding the equation of a line parallel or perpendicular to a given line that passes through a given point.	Major
HSG.GPE.B.6	13	Find the midpoint between two given points; and find the endpoint of a line segment given the midpoint and one endpoint. Note: An extension of this standard would be to find the point on a directed line segment between two given points that partitions the segment in a given ratio.	Major
HSG.GPE.B.7	13	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles. Note: Examples should include, but are not limited using the distance formula and area of composite figures.	Major

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Domain: Geometric measurement and dimension
Cluster(s): 14. Explain volume formulas and use them to solve problems
15. Visualize relationships between two-dimensional and three-dimensional objects

HSG.GMD.A.1	14	Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *For example: Use dissection arguments, Cavalieri's principle, and informal limit arguments.*	Additional
HSG.GMD.A.2	14	(+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.	Additional
HSG.GMD.A.3	14	• Use volume formulas for cylinders, pyramids, cones, spheres, and to solve problems which may involve composite figures • Compute the effect on volume of changing one or more dimension(s). *For example: How is the volume affected by doubling, tripling, or halving a dimension?*	Supporting
HSG.GMD.B.4	15	• Identify the shapes of two-dimensional cross-sections of three- dimensional objects • Identify three-dimensional objects generated by rotations of two-dimensional objects.	Additional

Domain: Modeling with Geometry
Cluster(s): 16. Apply geometric concepts in modeling situations

HSG.MG.A.1	16	Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).	Major
HSG.MG.A.2	16	Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).	Major
HSG.MG.A.3	16	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).	Major

App

Key:

ASM Domain and Standard #	ASM Cluster	ASM Standard	Course Emphases (Category)